Polarized Protons
Project Status and Plans

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RHIC Requirements for Polarized Proton Operation

- 25 GeV ----> 250 GeV
- Longitudinal polarization at major experiments
- Full Siberian Snake(s)

  ⇒ (1.8)(250 - 25) = 405 imperfection resonances, plus many intrinsic resonances

- Need fine vertical orbit control / correction

  ⇒ investigating harmonic and other correction schemes

Project Funding -- Primarily from RIKEN

- Funding for Accelerator Components: 1B Yen ($10 M)

(Less, due to exchange rate!)

constant issue... (4/27/98: 132 Y/$)

Superconducting Magnet System Requirements

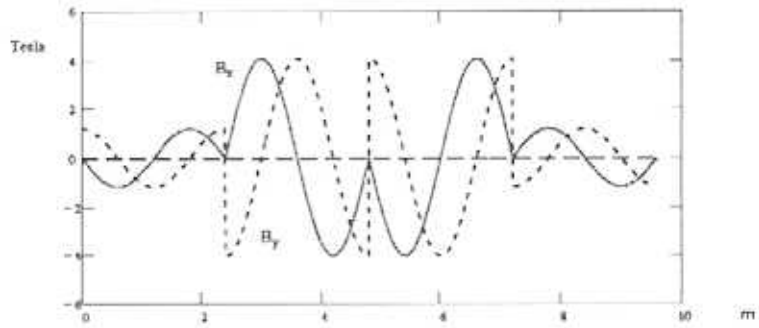
For the Siberian Snakes and Spin Rotators in RHIC:

- Works for 250 GeV Protons with reasonable field strengths
- Large aperture, for necessary orbit distortions, ...
- ... yet high field to keep orbit distortions small and local
- Low current (low heat-leak through power leads) and tunable
- Fits in available space in RHIC ring
- Minimize number of different components to be built

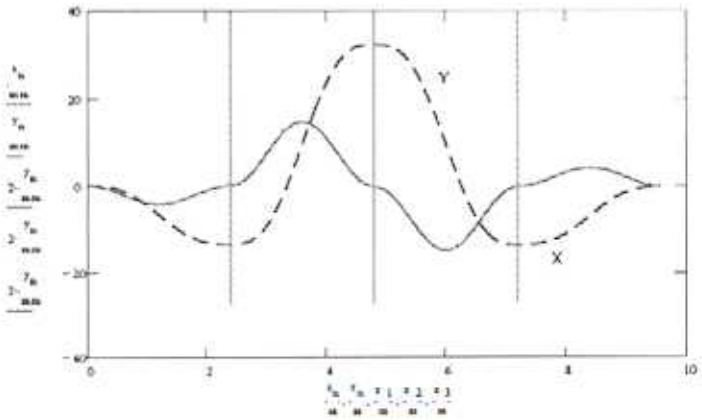
Nice solution for Snakes and Rotators proposed by Ptitsin and Shatunov (BINP), and refined at BNL over past few years, using helical dipole magnets...

- high field superconducting helical dipole magnets keep orbit distortions small and allow for the spin manipulations to be performed in a compact region
- four helical dipoles fit within standard RHIC straight section, keeping the assembly between already cold superconducting quadrupoles Q7 and Q8
- Rotators located in "warm" regions (which must be modified slightly), but modular design allows Snake and Rotator hardware to be as similar as possible
- low current, many-turn magnet designs being considered

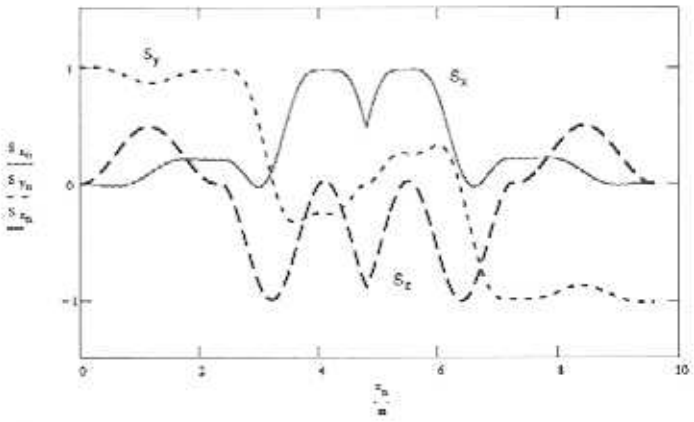
Magnetic Field through Snake Magnets

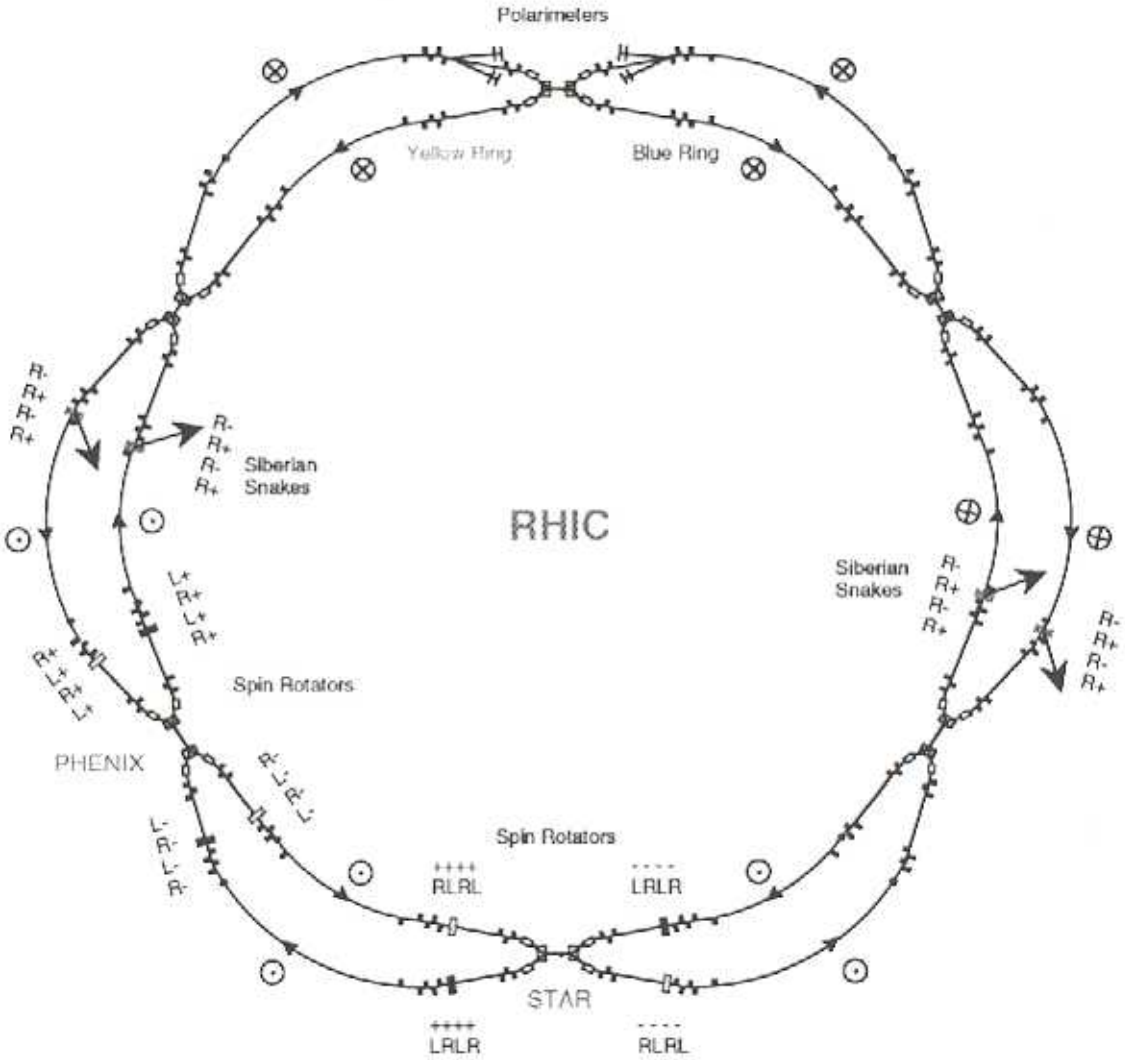


Proton Trajectory through Snake Magnets



Proton Spin through Snake Magnets





Rotators - Hor field (at ends), + - radially "out," - - radially "in"
Snakes - Ver field (at ends), + - "up," - - "down"

Present Project Status:

Accelerator Physics:

- Spin tracking studies concentrating on closed orbit correction schemes, crossing of strongest intrinsic resonances.

Magnets:

- Magnet R&D: success with both methods in making 4 Tesla helical dipole magnets! Slotted magnet more robust, chosen as design. >80% of Mechanical/Electrical drawings complete; most of remaining work is in cryostat assembly.
- Tooling (winding machine) is complete; most operational issues have been worked out. (Will still be learning things as we build first magnet.) Lamination stacking fixture nearly complete.
- Procurement of long-lead-time items (aluminum tubes, iron yoke laminations, superconductor) in good shape.
- First full-length production magnet was to begin in January; delays, primarily in tube machining. First full-length tube now mounted on winding machine and winding has begun.

Polarimeter:

- Toroid double-arm polarimeters are too expensive for our "actual" budget. Considering scaled-down, "day one" system.
- Looking at CNI system as second "day one" polarimeter, and future systems such as jets.

Roadmap Toward First Polarized Proton Run (Proposal)

T. Roser, M. Syphers

Goal: First polarized proton physics run in YEAR TWO (Oct. 2000 --->)
- 100 GeV on 100 GeV
- Longitudinal polarization at STAR and PHENIX

Need: Polarized proton commissioning during YEAR ONE (Oct. 1999 --->)
- one ring, two Snakes, one polarimeter; energies up to 100 GeV

A 4-week commissioning plan proposal for YEAR ONE (Oct. 1999 --->):

- Transfer of polarized beam from the AGS and injection into RHIC. Commission filling of RHIC with bunches of alternate polarization sign. (6 days)
- Commissioning of the polarimeter at 25 GeV. Check for systematic errors. (7 days)
- Measurement of beam polarization in RHIC at 25 GeV with and without Snakes.(4 days)
- Accelerate polarized beam to 40, 60, 80, and 100 GeV. Commission polarimeter and measure polarization at each energy. (11 Days)

Schedule calls for:

1. Two Siberian Snakes available for one RHIC ring by Summer 1999.
2. One polarimeter available for one (same!) RHIC ring by Summer 1999 -- operating range 25 GeV to 100 GeV.
3. Remaining components (2 Snakes, 8 rotators, 2nd polarimeter system) installed by Summer 2000.